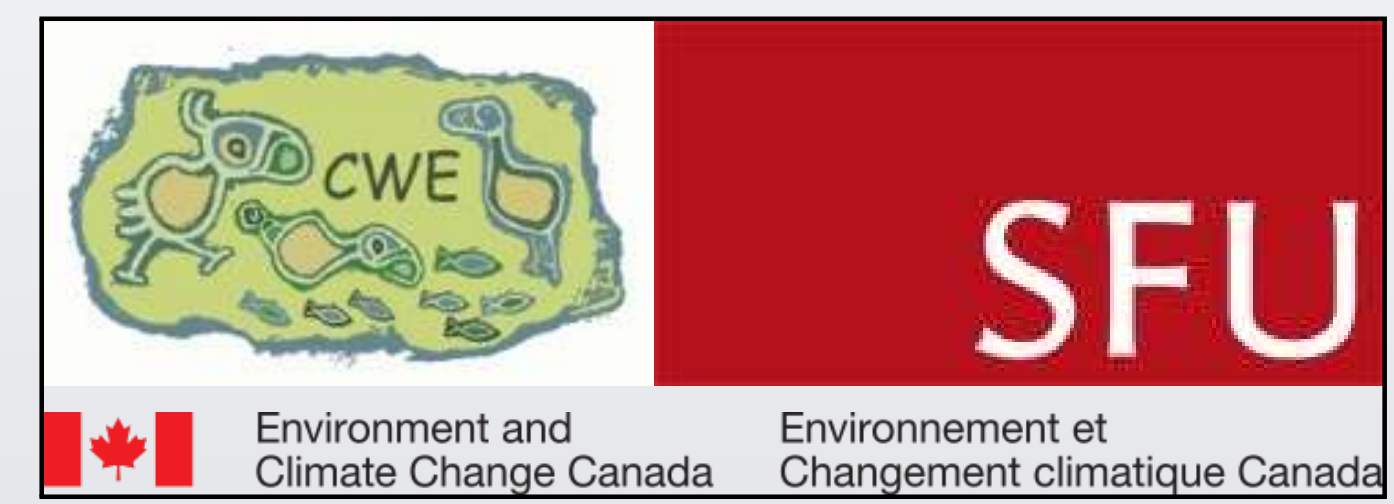
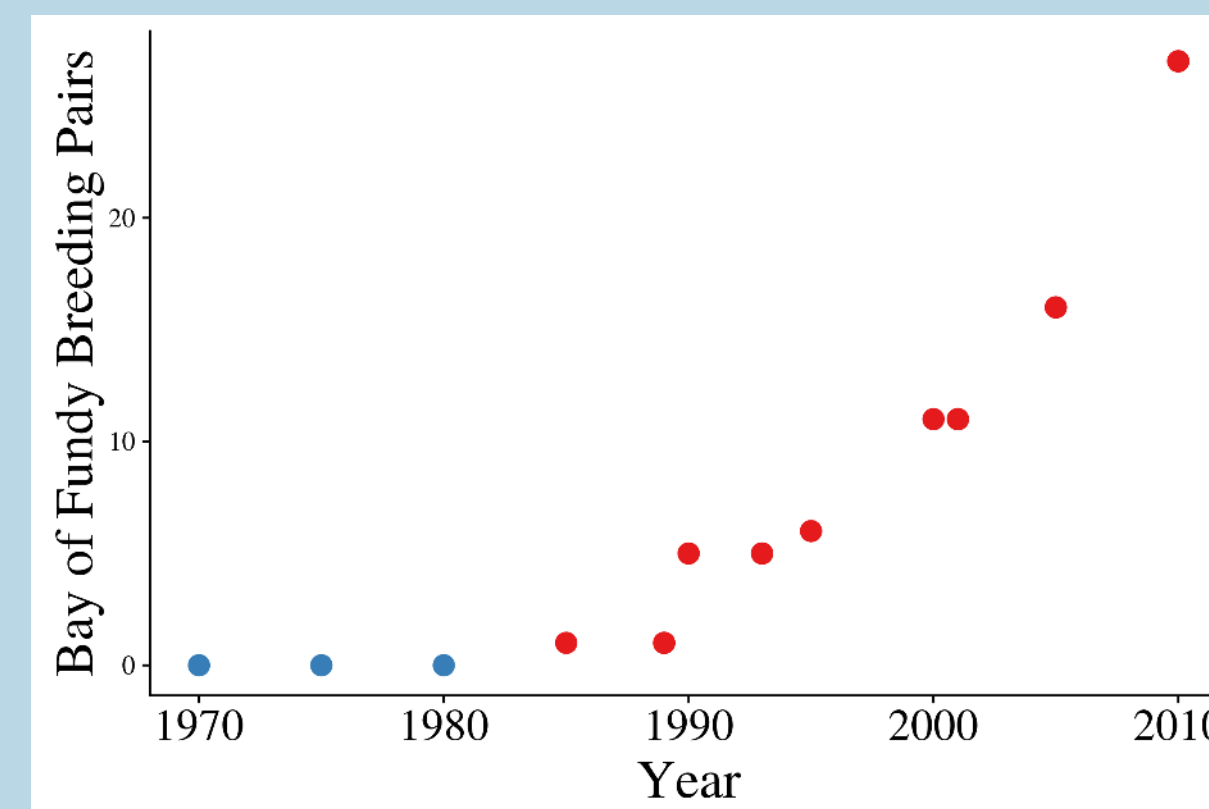
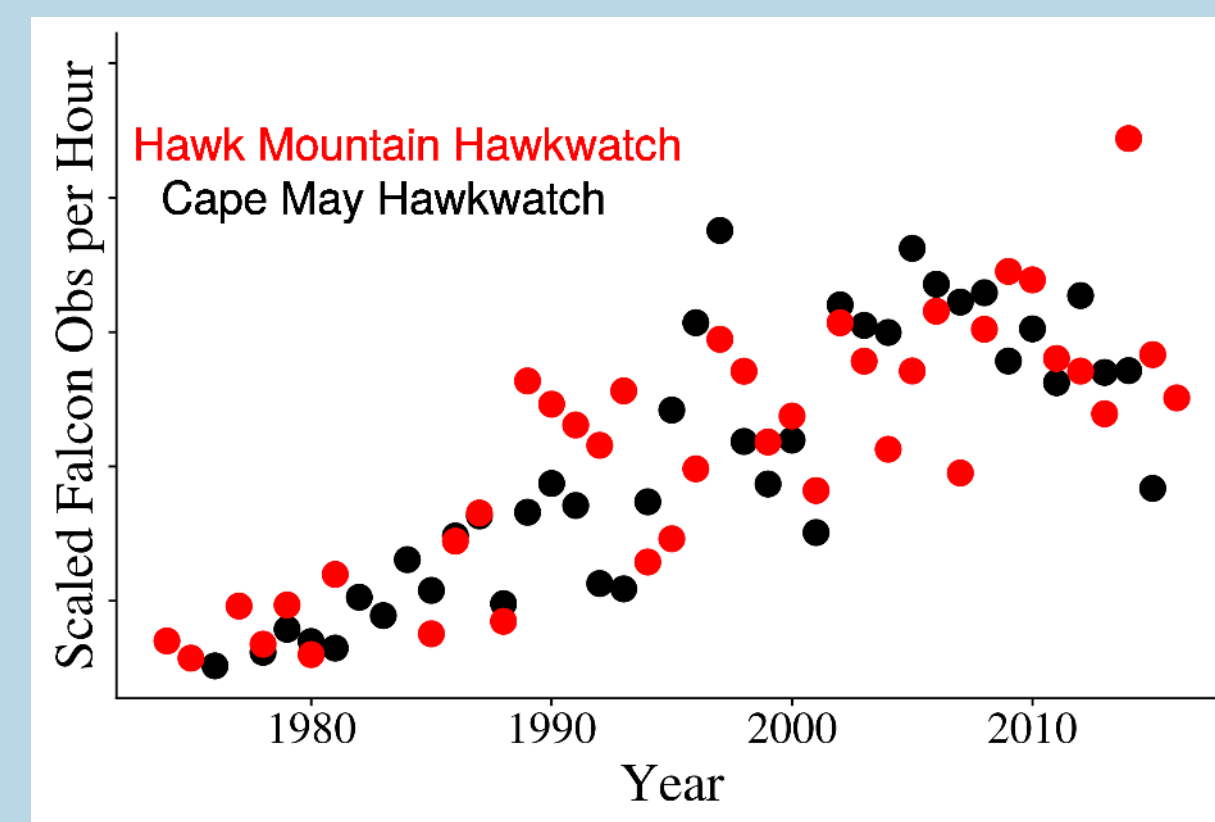


Semipalmated Sandpipers have shifted to safer stopover sites since 1974

David Hope¹, David Lank, and Ronald Ydenberg
¹dhope@sfu.ca



Continental increase in avian predator



- Dramatic increase in continental peregrine falcon populations.

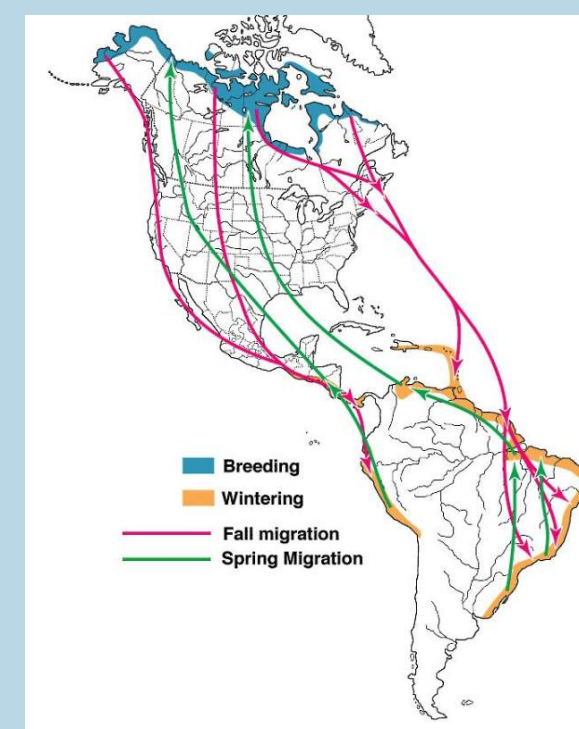
- Reintroduction of breeding populations at sites shorebird stopovers.

Semipalmated Sandpipers

- Long-distant migrant
- Conservation priority
- Abundant and gregarious
- Important prey item for Peregrine Falcons



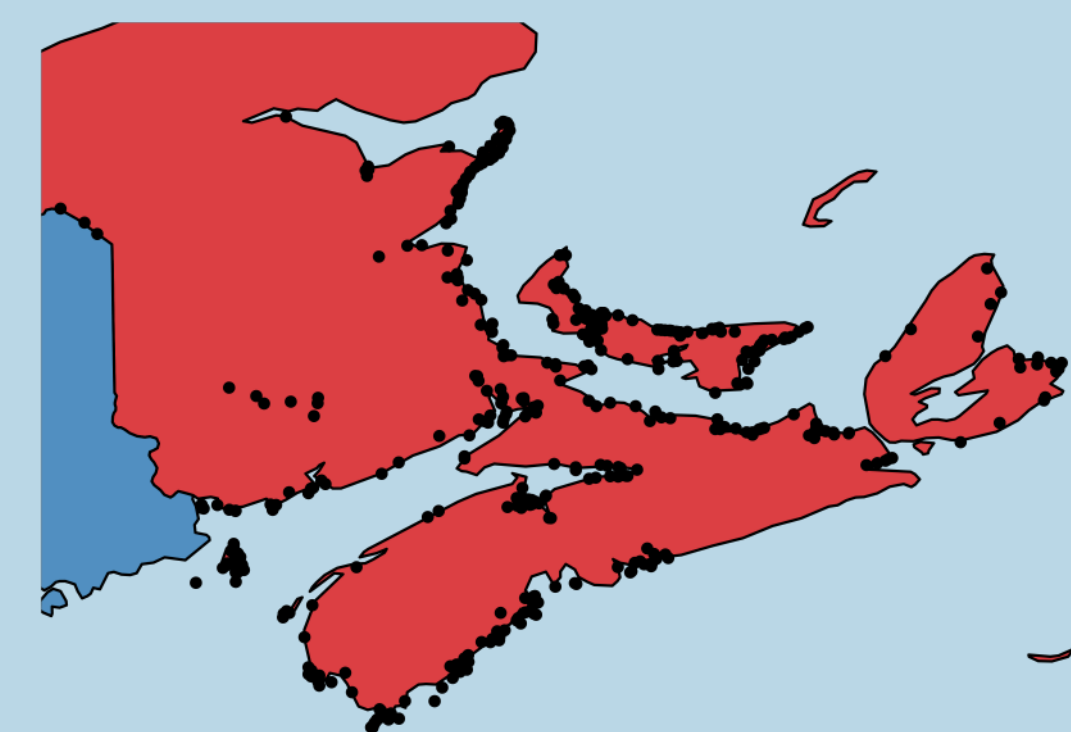
Source: John James Audubon Center



Source: Macaulay Library

Atlantic Canada Shorebird Survey

- Conducted annually by volunteers
- Standardized protocols
- 12 035 counts of 38 909 938 Semipalmated Sandpipers
- 42 years of surveys
- 270 sites

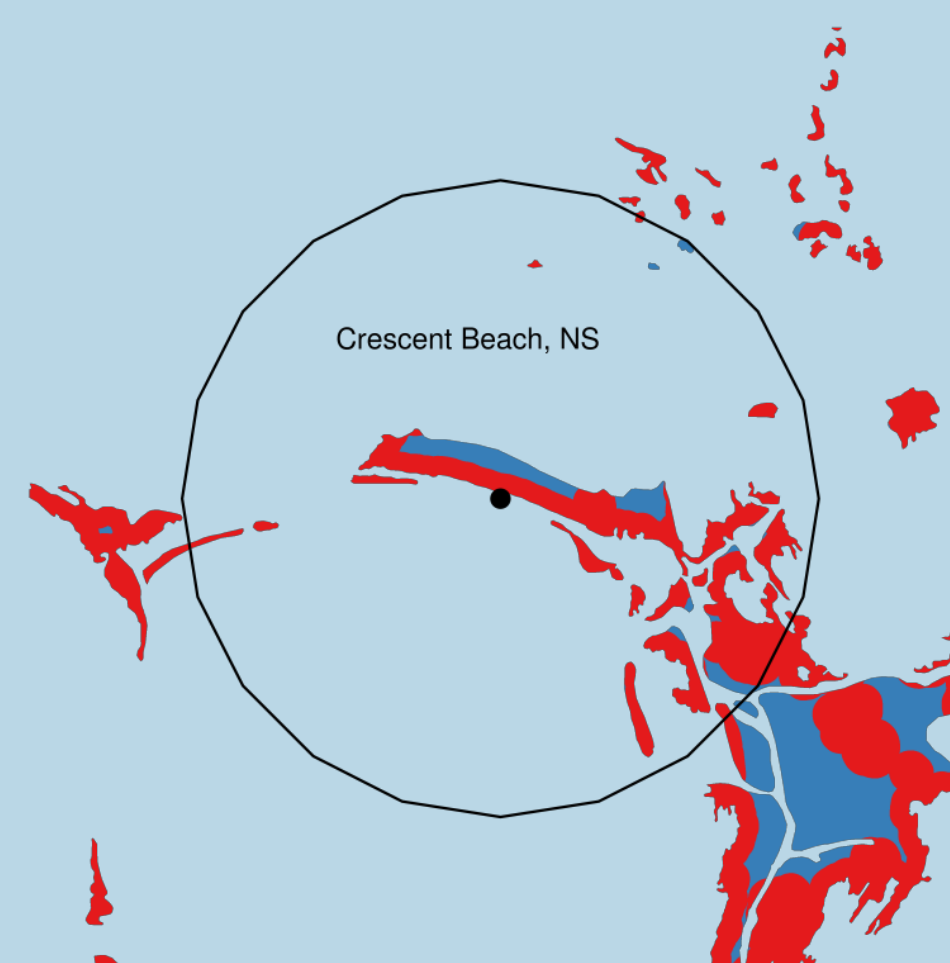


Sites vary in size and safety

Large, safe site



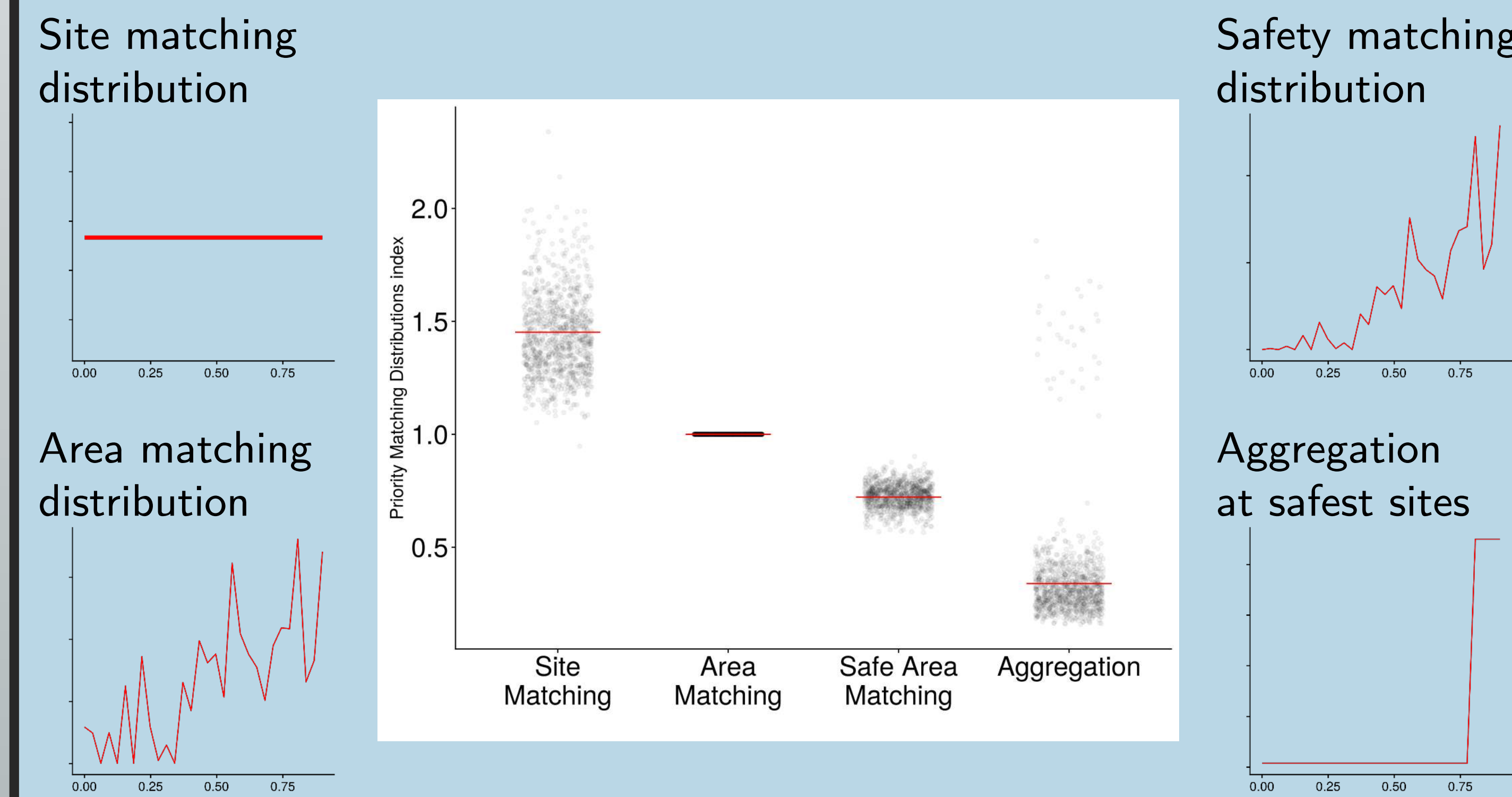
Small, dangerous site



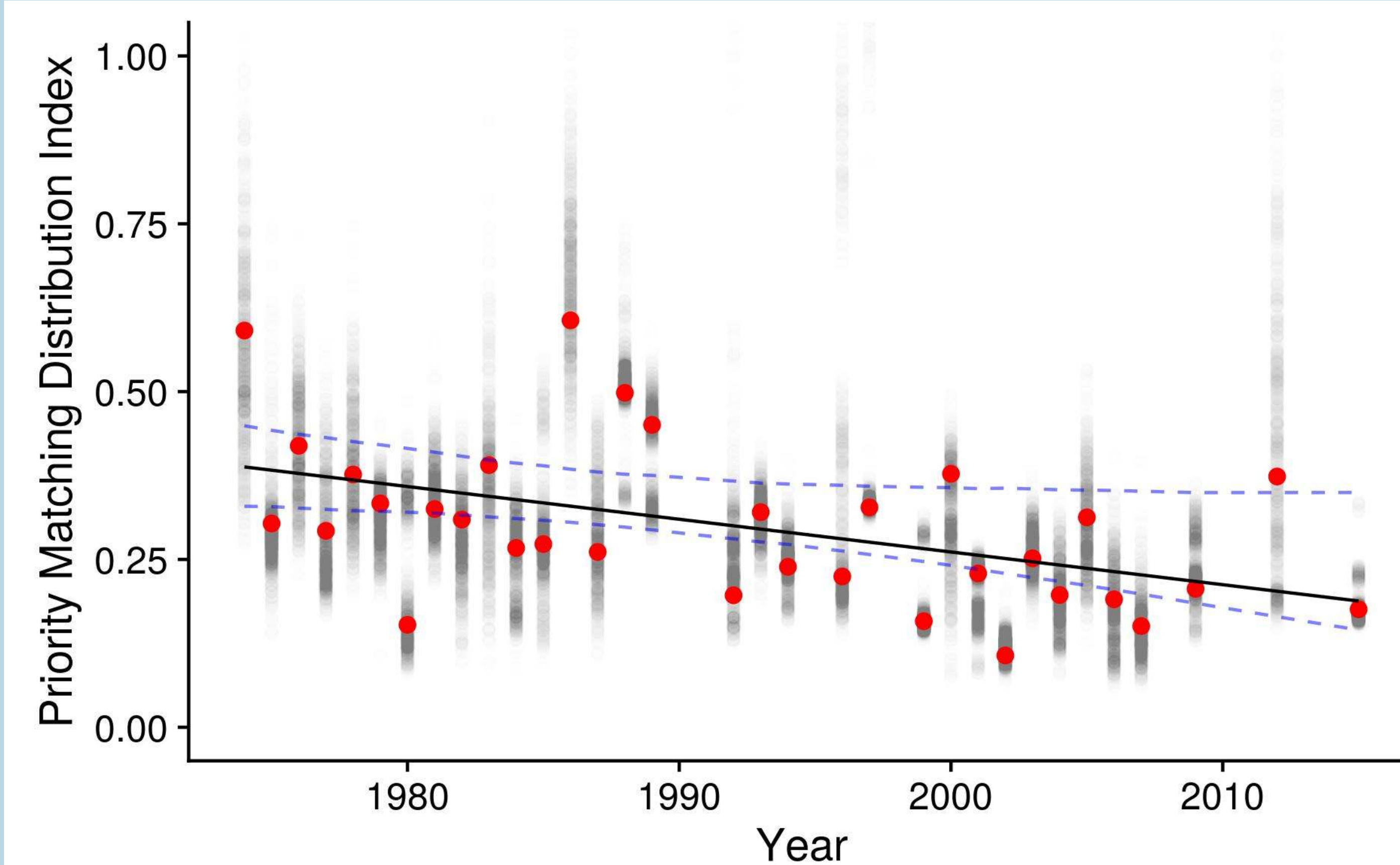
Predicted response to predator increase

1. Sandpipers redistribute away from the most dangerous sites
2. Sandpipers increase aggregation at safest sites

How distribution affects PMD index



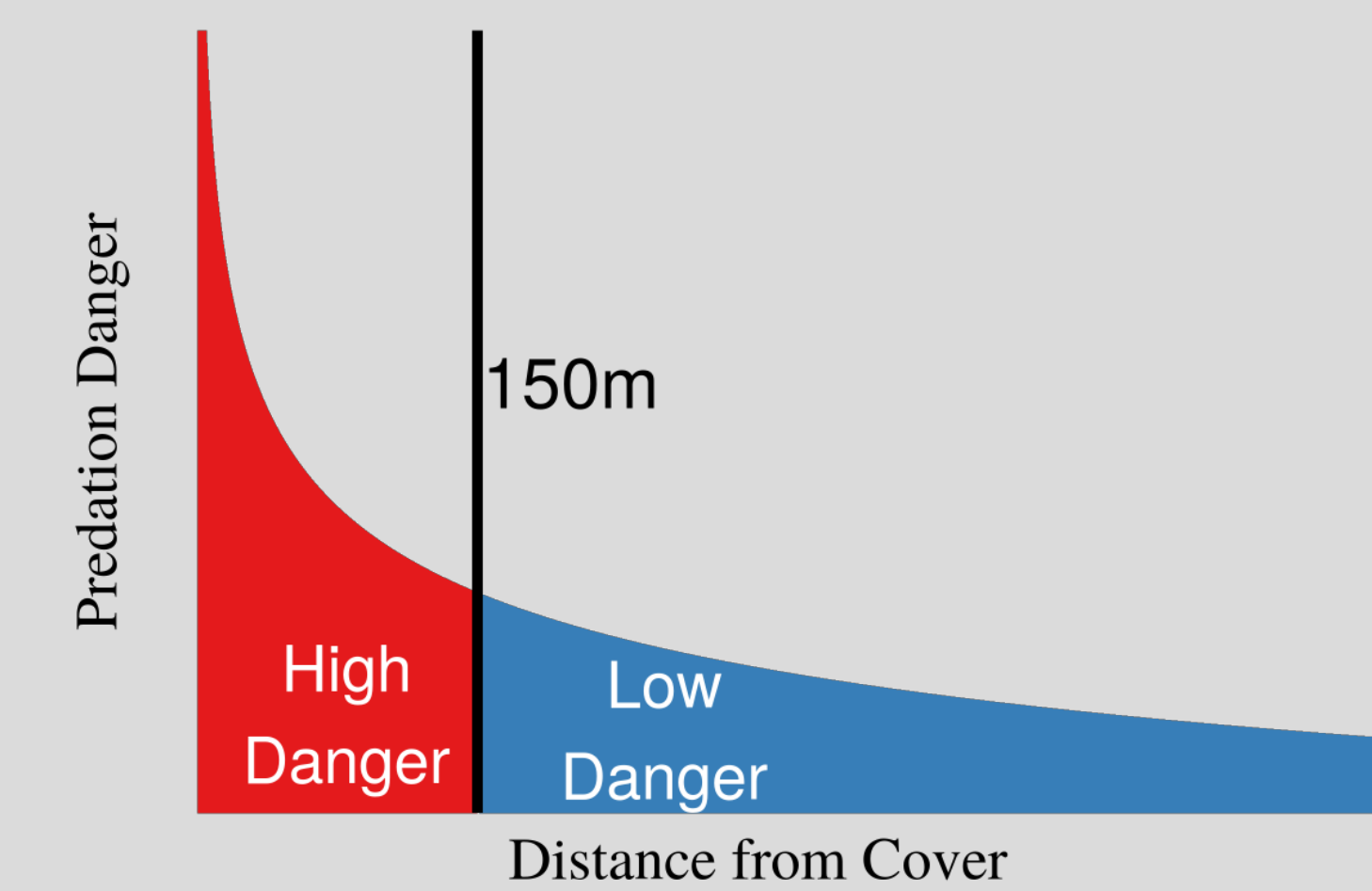
A shift to safety



Conclusions

- Semipalmated Sandpipers have increasingly prioritized safety in their stopover site selection.
- Likely in response to increases in continental predator population and the reintroduction of breeding predators in the region.
- Semipalmated sandpipers are increasingly aggregating at the safest sites.
- Response demonstrates the plastic nature of stopover decisions.
- Shift could have implications for population trend analyses that use migratory censuses.

Quantifying Site Danger



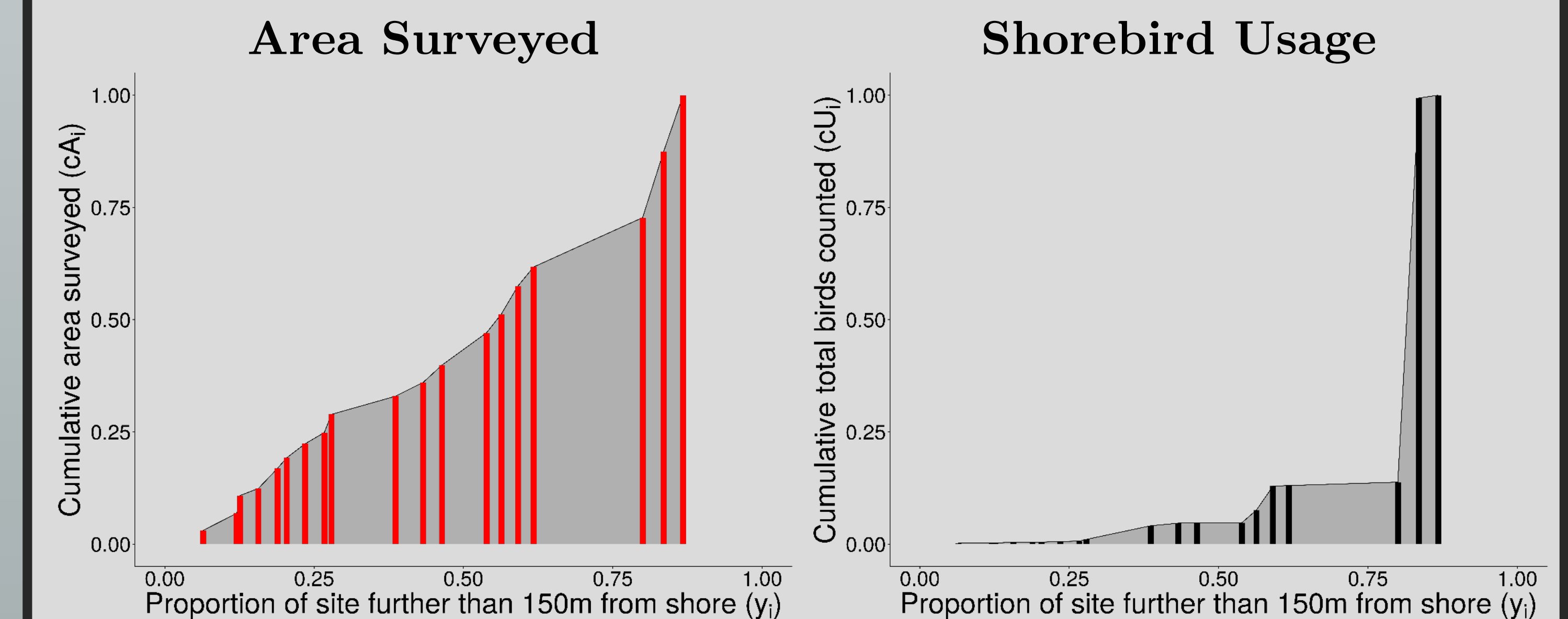
Area of intertidal = A_i

A_i within 150m of shore = D_i

Danger index = $x_i = \frac{D_i}{A_i}$

Safety index = $y_i = 1 - x_i$

Priority Matching Distributions (PMD) index



$$pA_i = \frac{A_i}{\sum_{n=1}^k A_n}$$

$$pU_i = \frac{U_i}{\sum_{n=1}^k U_n}$$

$$cA_i = \sum_{n=1}^i pA_n$$

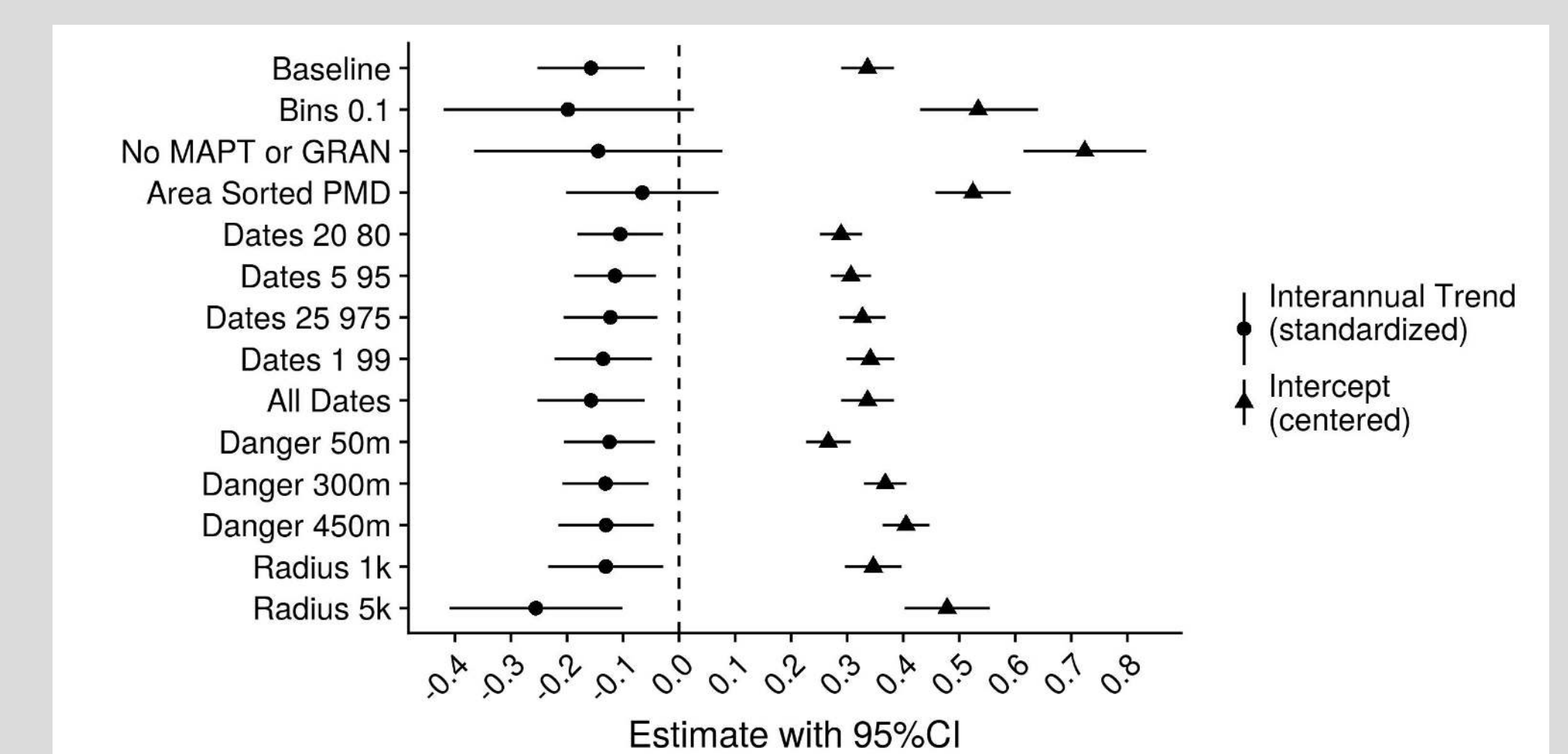
$$cU_i = \sum_{n=1}^i pU_n$$

$$\text{Area Under Distribution}_{Area} = \sum_{i=2}^k = \frac{(y_i - y_{i-1})(cA_i + cA_{i+1})}{2}$$

$$\text{Area Under Distribution}_{Usage} = \sum_{i=2}^k = \frac{(y_i - y_{i-1})(cU_i + cU_{i+1})}{2}$$

$$PMD = \frac{AUD_{Usage}}{AUD_{Area}}$$

Testing Assumptions of PMD



Acknowledgments

Thank you to Paul Smith and Julie Paquet at the Canadian Wildlife Service for getting us started with the data. ACSS data is available through Bird Studies Canada's NatureCounts portal at www.birdscanada.org/birdmon/.